



## Help for the Steel Industry

*Among spinoffs that aid industrial productivity and manufacturing technology are advances in steelmaking techniques*

Until the 1960s, the United States led the world in steel production. In the years since, however, the American steel industry has fallen behind Japanese and European companies in the fiercely competitive international market.

Today, American steelmakers are seeking to regain lost ground by modernizing their facilities and production techniques. Among recent improvements is the use of more efficient equipment in the

steelmaking process known as continuous casting, which accounts for some 60 percent of the 100 million tons of steel produced annually in the U.S. NASA contributed to this effort by adapting aerospace high temperature metal technology to the continuous casting process.

NASA's help came from a collaboration between Lewis Research Center and Gladwin Engineering, East Palestine, Ohio, a manufacturer of equipment used by steelmakers in continuous casting of steel slabs and billets (steel bars).

Continuous casting is generally more efficient than conventional ingot casting because it takes less time and labor. Gladwin is one of the few U.S. companies producing continuous casting equipment.

Improvements in this area of steel production equipment are particularly important to the competitive status of the U.S. industry. Seeking such improvements, Gladwin approached NASA to see if aerospace technologies might be applied to steelmaking processes. Says Gladwin Chief Engineer, George J. Wagner:

"Our equipment was as good as or better than anyone else's, but we didn't want to play 'me too.' We wanted to be the best in the world.

"We had a list of about 20 technology items that we feel are holding back the ability of the U.S.A. to produce more steel and better quality semi-finished products. We knew we wouldn't be able to tackle all of these areas at once, so we focused on a couple of things we



Gladwin Engineering's George J. Wagner and Lewis Research Center materials expert William J. Waters examine steel-processing rollers cracked by thermal stress. A Lewis team solved Gladwin's cracking problem by applying space technology.



*really* wanted to improve — mold life and roller life.”

In the continuous casting process, equipment is subjected to an extremely hostile environment. Thick multi-ton sheets of semi-molten metal slide rapidly across metal mold surfaces, causing wear and failure on the contact surfaces. Chemical fluxes used in the casting process form acids that attach and corrode the metal mold. After exiting the mold area, the hot steel slabs are transported over a series of metal rollers that reach 1800 degrees Fahrenheit on the top contact surface, while the bottom surface is cooled by water mist.

These operating conditions caused cracking of the rollers due to thermal fatigue. Erosion of the mold surface plates was caused by friction, high temperature and acids. Improving roller and mold life were considered the two main factors in keeping the casting line running, the key to more efficient, less costly steel production. A continuous casting line costs upwards of \$100 million and down time results in production losses ranging from \$10,000 to \$150,000 per hour.

Materials engineers of Lewis Research Center's Technology Utilization Office tackled the problems. A period of extensive experimentation led to a breakthrough involving application of materials originally developed for aerospace systems to continuous casting hardware.

Specifically, Lewis offered as a solution to the roller-cracking problem: use of a high temperature material once used on the X-15 research plane. Applied to the rollers by a special spraying technique developed at Lewis, a thin layer of the material would provide resistance to thermal shock and cracking. To reduce wear on the mold surfaces while maintaining a high heat transfer capability, Lewis supplied mold prototypes of metal composites that



Wagner checks newly machined rollers that incorporate the NASA technology, which allowed a threefold improvement in roller lifetime.

reduced erosion and promoted the desired thermal conductivity in the critical initial solidification area.

Both measures proved successful. Roller life has improved dramatically. Where the average roller used to last for about 300,000 tons of steel, the improved roller can handle a million tons or more. Improvements of two to three times over previous mold life were also realized.

Only a few months after introducing the improved components, Gladwin posted large sales increases, helping the company to keep its share of the continuous casting equipment and maintenance market despite intense foreign competition. The company anticipates additional improvements through continued NASA cooperation.

“I have to say that NASA technology has definitely helped us,” says Chief Engineer Wagner, “but it goes much further than that. The real benefit goes to the U.S. steel industry — an industry that needs help.”